TWO-PIECE BRUSHROLL

Background of the Invention

The present invention relates in general to suction cleaners. More particularly, the invention relates to an improved rotary brushroll assembly for mounting in a suction inlet of a suction cleaner, such as a vacuum cleaner, and will be described with particular reference thereto. However, it is to be appreciated that the present invention may also be amenable for other applications.

The use of rotary brushrolls in cleaning apparatus such as vacuum cleaners is well known. Prior art vacuum cleaner brushrolls generally include an elongated cylindrical roll body rotatably supported in various constructions at either end by bearings connected to adjacent sides of a vacuum cleaner suction opening. The roll body is rotated by a belt operably connected to a vacuum cleaner motor. The motor driven belt rotates the brushroll to dislodge dirt and debris on a surface to be cleaned allowing permanent removal of the dislodged dirt and debris by appropriate air suction into the suction opening.

More specifically, the brushroll body carries on its outer surface an array of tufted bristles or tufts extending radially outward from the outer surface. The tuft array is distributed regularly about the periphery of the roll body to balance the moments of inertia about the roll body axis. As the roll body rotates, the tufts contact the surface, such as a carpet, and loosen dirt or debris from carpet fibers. The tufts are generally mounted in a helical pattern to better facilitate this removal of

debris from the carpet fibers as the vacuum cleaner moves over the carpet surface. Suction within the suction opening then moves the loosened dirt and debris to a filter/storage area of the vacuum cleaner.

Previously, wooden dowels were used for brushrolls. Now, many manufactures have switched to plastic. The prior art plastic brushroll bodies are each often fabricated as a single, unitary piece from a relatively expensive plastic material using conventional manufacturing techniques, such as injection molding, for durability. If an inexpensive type of plastic were used, the brushrolls would function properly initially but after extended use the portion of the brushroll body that is contacted by the motor driven belt would degrade. Eventually this degradation can cause the engagement between the belt and the brushroll to fail thereby disabling the rotation function of the brushroll.

Thus, there remains a need for a brushroll that remains reliable over an extended use period while continuing to be relatively simple and inexpensive to fabricate, assemble, and operate. The present invention provides a new and improved brushroll for use in a vacuum cleaner for overcoming the above-referenced drawbacks and others.

Summary of the Invention

In accordance with the present invention, a new and improved roll assembly for use in a vacuum cleaner is provided.

More particularly in accordance with this aspect of the invention, the roll assembly comprises a housing, an elongated roll body and an agitator extending radially away

from the roll body, and a pulley section mounted to one end of the elongated roll body wherein the roll body and the pulley section are rotatably mounted to the housing.

According to another aspect of the present invention, a new and improved roller assembly for use in a suction cleaner is provided.

More particularly in accordance with this aspect of the invention, the roller assembly comprises a housing having a suction opening and a roller mounted adjacent the suction opening. The roller comprises an elongated roller body comprising a first material and a pulley section comprising a second material. The pulley section is axially connected to the elongated roller body.

According to still another aspect of the present invention, a new and improved brushroll for a vacuum cleaner is provided.

More particularly in accordance with this aspect of the invention, the brushroll comprises a roll body including a first end, a second end and a rotational axis. A first bore extends from the first end to the second end of the roll body along the rotational axis. The roll body further includes a first connecting element located at the roll body second end. The brushroll further comprises a pulley section including a first end, a second end and a pulley rotational axis. A second centrally positioned bore extends from the pulley first end to the pulley second end of the pulley section along the pulley rotational axis. The pulley further includes a second connecting element located at the pulley first end for engaging the first connecting element. A shaft extends through the first and second bores. At least one bearing is mounted on the shaft and rotatably positions the roll body and the pulley on the shaft.

Brief Description of the Drawings

The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIG. 1 is a bottom plan view of a vacuum cleaner showing a brushroll assembly mounted in a suction opening of the vacuum cleaner in accordance with the present invention;

FIG. 2 is an exploded perspective view of a mirror image of the brushroll assembly of Fig. 1 showing a roll body, a pulley, and a pair of mounting assemblies;

FIG. 3 is an enlarged exploded side elevational view of the brushroll assembly of FIG. 2 showing a pulley end thereof;

FIG. 4 is an assembled cross-sectional view of the pulley end of FIG. 3;

FIG. 5 is an enlarged exploded side elevational view of the brushroll assembly of FIG. 2 showing a roll body end thereof; and

FIG. 6 is an enlarged assembled cross-sectional view of a portion of the roll body end of FIG. 5.

Detailed Description of the Preferred Embodiment

Referring now to the drawings wherein the showings are for purposes of illustrating the preferred embodiment of the invention only and not for purposes of limiting the same, FIG. 1 shows the underside of a vacuum cleaner **A** having a main suction opening **B** formed therein. The vacuum cleaner **A** comprises a filter chamber (not shown)

for separating dust and dirt from a suction air stream and a suction source (not shown) in fluid communication with the main suction opening **B**. A brushroll assembly **10** is operatively mounted for rotation within the suction opening **B**. A selectively moving motor-driven belt **C** frictionally engages a portion of the brushroll assembly **10** providing a means for rotating the brushroll assembly **10**. While the vacuum cleaner **A** is of an upright type, it should be appreciated by those of average skill in the art that the present invention described and illustrated herein could also be employed for use on remote nozzle vacuum cleaners such as canister vacuum cleaners, wet/dry vacuums and central vacuums which can employ a rotating brushroll as well as carpet extractors and hand-held vacuum cleaners and in a variety of other brushroll type cleaners.

With reference now to FIG. 2, the brushroll assembly **10** comprises a brushroll **12** including an elongated roll body **14** threadedly connected to a pulley section **16**. A shaft **18** extends through both the roll body **14** and the pulley section **16**, since they are both hollow. A pair of substantially identical end mounting assemblies **20, 22** accommodate the ends of the shaft **18** and allow the brushroll **12** to be rotatably mounted. Each end assembly **20, 22** is operably connectable with a respective brushroll mounting structure (not shown) in the vacuum cleaner suction opening **B** (Fig. 1). The generally tubular brushroll **12** receives the shaft **18** therethrough. A first, pulley end **24** of the brushroll **12** connects to the first, pulley end assembly **20**. A second, roll body end **26** connects to the second, roll body end assembly **22**. The shaft **18** connects between the end assemblies **20, 22** and defines a brushroll rotational axis **28** along the brushroll **12** between its first and second ends **24, 26**.

More specifically, the roll body **14** includes a first roll body end **30** and, axially opposite, a second roll body end **32** that is the same as the second brushroll end **26**. The roll body **14** is formed as an elongated tube-like structure having an outer surface **34** and a coaxially cylindrical inner surface **36**. The inner surface **36** runs completely through the length of the roll body **14** defining a throughhole **38** (Fig. 6) therein for receiving the shaft **18**. Thus, the throughhole **38** extends from the first roll body end **30** to the second roll body end **32** along the brush roll rotational axis **28**. With reference now to Fig. 5, at the second roll body end **32**, a raised lip **40** extends radially outward around the circumference of the roll body **14**.

With additional reference to Fig. 2, the roll body **14** includes an agitator means which can be a pair of brush tufting arrays **50**, **52** extending radially outwardly from the outer surface **34** of the roll body **14** and spiral in a helical manner along the length of the roll body **14**. Of course, other types of conventional agitation means, such as beater bars, or the like could also protrude radially from a dowel instead of bristle tufts. In the embodiment illustrated, the brush tufting arrays **50**, **52** are positioned one-hundred and eighty degrees apart from each other. The tufting arrays may include gaps **53** extending around the circumference of the roll body **14** to accommodate structural elements extending across the suction opening **B** (Fig. 1). Further, with specific reference to Fig. 5, each pair of brush tufting arrays **50**, **52** may be mounted on a raised portion **54** of the outer surface **34** and has a plurality of tufts **56** extending therefrom. The brush tufts **56** may be attached to the raised portion **54** by any known conventional

means. During rotation of the brushroll **12**, the brush tufting arrays **50**, **52** are effective to loosen and pick up dirt and debris from a surface, such as carpeting, which is to be cleaned by the vacuum cleaner **A**.

With reference to Fig. 4, a first connecting element **58** is provided adjacent the first roll body end **30**. The connecting element **58** can be a counterbore **60** immediately adjacent the first roll body end **30** and a set of internal threads **62** defined along a portion of the inner surface **36** near the first roll body end **30** and immediately adjacent the counterbore **60**. With reference to Fig. 6, an angled mating surface **42** is provided for engagement with one of the end assemblies **22** at the second roll body end **32**. Adjacent the angled mating surface **42**, an axial flange **44** is provided.

With reference to Fig. 3, the pulley section **16** includes a first pulley end **64** that is the same as the brushroll end **20**. Axially opposite the first pulley end **64**, the pulley section **16** includes a second pulley end **66**. Similar to the roll body **14**, the pulley section **16** is formed as a tube-like structure and includes a raised lip **67** extending radially outward around the circumference of the pulley section **16**. With reference to Fig. 4, the pulley section **16** includes an inner surface **68** and a generally coaxially cylindrical outer surface **70**. The inner surface **68** extends along the length of the pulley section **16** defining a throughhole **72** therein. However, unlike the roll body **14**, the elongation of the pulley section **16** is abbreviated. Further, with additional reference to Fig. 3, the pulley section **16** includes three unique sections, a tuft section **74**, a belt section **76**, and a connector section **78**.

The tuft section 74 includes a pair of pulley brush tufting arrays 80, 82 extending radially outwardly from the pulley outer surface 70 along the longitudinal length of the tuft section 74 and helically relative to the brushroll rotational axis 28. Like the roll body 14, each of the pulley brush tufting arrays 80, 82 is positioned one-hundred and eighty degrees relative to each other and each of the pair of pulley brush tufting arrays 80, 82 includes a raised portion 84 relative to the outer surface 70 with a plurality of tufts 86 extending therefrom. The tufts 86 are attached to the raised portion 84 in the manner described above in reference to the roll body tufting 56. The tuft section 74 carrying the array of brush tufting 80, 82 is adjacent the first pulley end 64. With reference to Fig. 4, a second angled mating surface 98 is provided for engagement with the other of the end assemblies 20 at the first pulley end 64. Ajacent the angled mating surface 98, an axial flange 99 is provided.

With reference again to Fig. 3, the connector section 78 includes a second connecting element 88 located adjacent the pulley section second end 66 for engaging the first connecting element 58 of the roll body 14. With additional reference to Fig. 4, the second connecting element 88 includes a nose portion 90 for engaging the inner surface 36 of the roll body 14, an externally threaded portion 92 for threaded engagement with the internal threads 62 defined on the roll body inner surface 36, and a raised portion 94 for mating engagement with the counterbore 60 of the roll body 14. When the pulley section 16 and the roll body 14 are threadedly engaged to one another, the first roll body end 30 mates with a radial edge 96 of the pulley section 16 and the respective outer

surfaces **34**, **70** of the pulley section **16** and the roll body **14** are circumferentially flush or contiguous with one another near the mated engagement of the radial edge **96** and the first roll body end **30**.

With specific reference to Fig. 3, the belt engaging section **76** extends along a central portion of the outer surface **70** between the tuft section **74** and the connector section **78** and around the entire circumference of the pulley section **16**. As shown in Fig. 4, the belt engaging section **76** is thickened and adapted to be frictionally engaged by the belt **C** (Fig. 1) of the vacuum cleaner **A**. As discussed above, the belt **C** is selectively motor driven and, through the frictional engagement with the belt section **76**, rotates the pulley section **16**, and hence the entire brushroll **12**, when actuated.

When the pulley section **16** and the roll body **14** are connected to one another, the pulley throughhole **72** and the roll body throughhole **38** together form a single, elongated brushroll throughhole extending along the entire length of the brushroll and concentric with the brush roll rotational axis **28**. The shaft **18** is received through the brushroll throughhole **38**, **72** for operatively supporting the brushroll **12** within the suction opening **B** of the vacuum cleaner **A** (Fig. 1). More specifically, the brushroll **12** is connected to the shaft **18** by the end assemblies **20**, **22** and together the shaft **18** and the end roll assemblies **20**, **22** operatively and rotatably support the brushroll **12** in the suction opening **B**.

With reference to Fig. 2, the mounting assemblies **20**, **22** each include an annular bearing **100**, a bearing support **102**, and an end cap **104**. With additional reference to Figs. 4 and 6, each annular bearing **100** is fitted onto

the shaft **18** and positioned near an end thereof. The engagement between the shaft **18** and the annular bearing **100** may be characterized as frictional and nonrotational. Each bearing support **102** connects between the bearing **100** and the brushroll **12**. More specifically with reference to Fig. 4, the bearing support **102** is positioned at the first end **24** of the brushroll **12** and connects between the respective bearing **100** and the pulley section **16**. With reference to Fig. 6, the bearing support **102** is positioned at the second end **26** of the brushroll **12** and connects between the respective bearing **100** and the roll body **14**.

With reference to Figs. 4 and 6, each bearing support **102** includes a nose **106** for engagement with either the inner surface **36** of the roll body **14** at the second brushroll end **26** or the inner surface **68** of the pulley section **16** at the first brushroll end **24**. The nose extends in a direction parallel to the brushroll rotational axis **28** (Fig. 2). An angled surface **108** extends radially outwardly from the nose **106** and mates with respective first and second mating surfaces **42, 98** of the roll body **14** and the pulley section **16**. A thread-retarding flange **110** extends from the axially distal end of the angled surface **108** and parallel to the nose **106**. The thread retarding flange **110** extends axially a dimension sufficient to retard thread and like string material from undesirably becoming wound on the shaft **18**.

The end of the shaft **18** and the corresponding thread retarding flange **110** rotatably engage or mount into a respective end cap **104**. The end caps **104** are securely received within the ends of the suction opening **B** (Fig. 1) and serve as holding devices for the shaft **18** and the brushroll **12**. The end caps **104** each include a centrally

positioned cup **114** generally concentric with the brushroll rotational axis **28** (Fig. 2). The cups **114** each receive an end of the shaft **18** and prevent radial movement of the shaft **18** relative to the end cap **104**. The pair of cups **114**, one at each end of the shaft **18**, together prevent axial movement of the shaft **18** relative to the opposing, pair of end caps **104** and the suction opening **B**. The end caps **104** also each include an outer annular cup **116** for receiving the thread retarding flange **110** of the respective bearing supports **102**. Together, the annular cup **116** and the flange **110** form a labyrinth seal. The outer annular cups **116** are axially shorter relative to the cups **114** but are concentric therewith.

Prior art brushrolls were commonly formed as a single unitary piece of wood. More recently, plastic has become the material of choice. It has been found, however, that the frictional engagement between the vacuum belt **C** and the pulley portion of a prior art brushroll often caused a significant amount of wear on the pulley portion and premature failure thereof. To prevent such failure, brushrolls could be constructed of a more wear resistant material, such as glass-filled polypropylene, which is known to have increased wear resistance as compared to softer plastics. However, manufacturing an entire brushroll of glass-filled polypropylene can be rather expensive and may be cost prohibitive.

Therefore, the present invention provides a two-piece brushroll **12** wherein the roll body **14** may be constructed of conventional, softer, less expensive plastic materials, such as polypropylene, and only the pulley section **16** may be made of a relatively hard, wear-resistant, more expensive material, such as a glass-filled polypropylene material. Conventional manufacturing

techniques, such as injection molding, may be employed to make the roll body **14** and the pulley section **16**.

As discussed above, the pulley section **16** includes the male threaded portion **92** that threadedly engages the female threads **62** of the roll body **14**. In this arrangement, the glass-filled polypropylene pulley section **16** which includes a belt engaging section **76** is able to withstand the increased wear caused by engagement with the vacuum belt **C**. However, the increased material and manufacturing costs associated with the more wear resistant material, in this case a glass-filled polypropylene material, are not added to the entire brushroll **12**. Rather, the more expensive material is used only in the region of the brushroll **12** requiring increased wear resistant properties.

It should be appreciated by those of average skill in the art that other materials can be used to manufacture or form the pulley section **16** and the roll body **14**. One of the features of this invention is the use of differing materials for the brushroll **12** to increase the wear resistance to belt-wear of the brushroll **12** in the area of the brushroll **12** that is engaged to the belt **C**. Another feature of this invention is the use of differing materials in a brushroll **12** to limit or lessen both the material and manufacturing costs associated with making the brushroll **12** more wear resistant. Accordingly, other materials could be used to achieve similar results and all such combinations of materials are to be considered within the scope of the present invention.

Yet another feature of this invention is the use of multiple components threadedly connected to one another, in this case the roll body **14** and the pulley section **16**.

Although the embodiment herein described includes a pulley section **16** having a male threaded portion **92** and a roll body **14** having female threads **62** for threadedly connecting to the male threaded portion **92**, the male and female threaded relationship could be reversed. Preferably, in either arrangement, the threading relationship is such between the roll body **14** and the pulley section **16** that as the brushroll **12** is rotated, the roll body **14** and the pulley section **16** are spun into closer engagement with each other, rather than being spun away from each other.

Furthermore, it should also be appreciated by those of average skill in the art that other means of connecting the pulley section **16** and the roll body **14** can be used. For example, the pulley section **16** and the roll body **14** can be connected by a press fit connection wherein one of the pulley section **16** and the roll body **14** is pressed into the other of the pulley section **16** and the roll body **14**. Also, adhesives could be used to connect the components **14**, **16**, or a fusion process could be used to weld the roll body **14** and the pulley section **16** together. These and other known connecting means are to be considered within the scope of the present invention.

The invention has been described with reference to a preferred embodiment. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they are within the scope of the appended claims or the equivalents thereof.